

**P.G. DIPLOMA IN ANALYTICAL CHEMISTRY  
(PGDAC)**

**Term-End Examination**

**February, 2021**

**MCH-003 : SPECTROSCOPIC METHODS**

*Time : 3 hours*

*Maximum Marks : 75*

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**Note :** Attempt any **five** questions. All questions carry equal marks.

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1. Answer any **five** of the following :  $5 \times 3 = 15$
- (a) List the factors responsible for the deviations from Beer-Lambert's law.
  - (b) State Franck-Condon principle and give its significance.
  - (c) Briefly discuss the types of special interferences in quantitative determination by flame photometry.
  - (d) What are the two types of sources of radiation used in AAS ? Explain in brief.
  - (e) Discuss the determination of sodium in serum using AEC.
  - (f) Explain why  $^{12}\text{C}$  does not show NMR whereas  $^{13}\text{C}$  is NMR active.

2. (a) Describe the standard addition method for quantitative determination using uv-vis spectrometry. 5
- (b) A solution containing 25.0 mg  $K_2Cr_2O_7$  per 100 mL was taken in a 1 cm cuvette and its transmittance was found to be 8 at 455 nm. Calculate molar absorptivity of  $K_2Cr_2O_7$  (Mol. wt = 294) 5
- (c) Describe the sampling methods of solids in IR spectrometry. Which one of these is more commonly used and is useful for calibration of instruments ? 5
3. (a) Draw a schematic representation of the experimental set-up of Raman spectrometer and describe the basic components. 5
- (b) State the rule of mutual exclusion and give its significance using a suitable example. 5
- (c) Define the term photoluminescence and explain its correlation with structure with suitable examples. 5
4. (a) Write the reactions occurring when the element is introduced into the flame in flame photometry. 5
- (b) Discuss the role of pneumatic nebuliser in flame photometry giving a schematic illustration. 5
- (c) Describe internal standard methods of calibration used for quantitative determination by flame photometry. 5

5. (a) What is Hollow Cathode Lamp (HCL) ? Describe all the components with the help of schematic diagram. 5
- (b) What is meant by anisotropy of chemical bonds ? Explain with the help of suitable examples. 5
- (c) What are the important aspects of sample handling in NMR spectroscopic identification ? Name the internal standard commonly used in sample preparation. 5
6. (a) Describe the fluorimetric determination of blood glucose using glucose oxidase and explain the mechanism. 5
- (b) Explain the principle of revolving can shutter systems used for the simultaneous measurement of fluorescence and phosphorescence. 5
- (c) Explain the origin of isotopic peaks in mass spectrum with suitable examples of any three elements which give these peaks. 5
7. (a) Draw a schematic diagram of an electrically heated graphite furnace and describe it briefly. 5
- (b) Explain various types of interferences encountered in atomic absorption spectrophotometry. 5
- (c) Describe the microwave digestion system used in AAS and discuss its usefulness in AAS with the help of a schematic diagram. 5

8. (a) Explain the nature of NMR spectrum of benzyl alcohol ( $C_6H_5CH_2OH$ ) in low resolution. What will happen if the spectrum is recorded in high resolution ? 5

(b) What do you understand by McLafferty molecular rearrangement ? Explain it considering the example of n-butanol ( $C_4H_9OH$ ) and discuss its mass spectrum. 5

(c) The important spectral details of an organic molecule having a molecular formula  $C_5H_{10}O$  are as follows :

Mass : (Prominent peaks at  $m/z = 41, 43$  (base peak); and  $86 (M^+)$ )

IR : ( $2937\text{ cm}^{-1}$  (m);  $1718\text{ cm}^{-1}$  (s);  
 $1428\text{ cm}^{-1}$  (m) and  $1254\text{ cm}^{-1}$  (m))

NMR : ( $\delta = 1.11$  (6H, d);  $\delta = 2.1$  (3H, s) and  
 $\delta = 2.58$  (1H, m))

Determine the structure of the organic molecule. 5

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